P-4.4 Compare how current, voltage, and resistance are measured in a series and in a parallel electric circuit and identify the appropriate units of measurement.

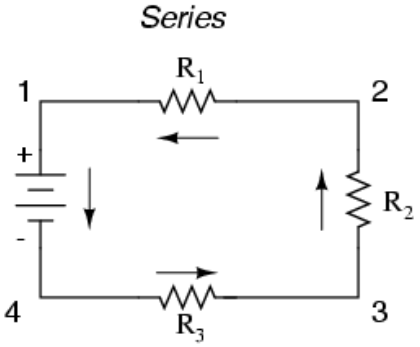
Revised Taxonomy Level 2.6 Compare conceptual knowledge

Key Concepts
Parallel circuit
Series circuit
Current, Voltage, Resistance

Students are first introduced to series and parallel electric circuits in forth grade. "Illustrate the path of electric current in series and parallel circuits." (4-5.7)
In physical science, students solve problems that involve simple circuits but they do not differentiate how to find total resistance, voltage, or current in series and parallel circuits.
In physical science students also "Represent an electric circuit by drawing a circuit diagram that includes the symbols for a resistor, switch, and a voltage source." (PS-6.8) and "compare the functioning of simple series and parallel electric circuits" (PS-6.9)

It is essential for students to

- Understand how multiple resistors in both series and parallel circuits affect the voltage, current and resistance at each resistor and throughout the circuit
  - In series circuits

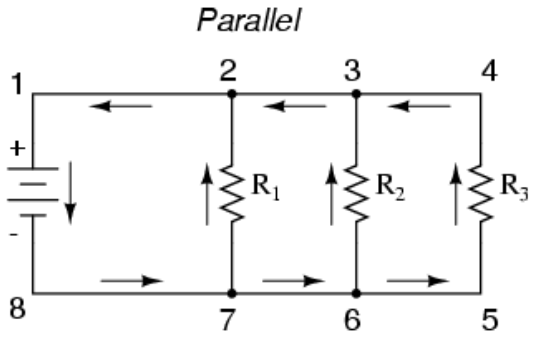


  - Current
    - The total current of the circuit is the same as the current at each location on the cell.
    - $I_T = I_1 = I_2 = I_3$
    - The current in a series circuit must pass through each cell or resistor. Students should understand conceptually that as the same current is flowing through the entire circuit, the current at every point is the same.
  - Voltage
    - The total voltage of the circuit will be equal to the sum of the voltage across each resistor
    - $V_T = V_1 + V_2 + V_3$

- The current in a series circuit must pass through each cell or resistor. Students should understand conceptually that the current is affected by a potential difference as it crosses each resistor or cell. The total voltage of the battery is the sum of the voltages of each cell. The sum of the voltage drops across each resistor is equal to the voltage of the battery.

♦ Resistance
- The total resistance of the circuit will be equal to the sum of the resistance across each resistor
- $R_T = R_1 + R_2 + R_3$
- The current in a series circuit must pass through each cell or resistor. Students should understand conceptually that the current experiences resistance as it crosses each resistor or cell and therefore is affected by the resistance at each one.

➢ In parallel circuits



♦ $I_T = I_1 + I_2 + I_3$
- The current in a parallel branch of a circuit is divided at each branch of the circuit, part of the current going through each path. Students should understand conceptually that as different amounts of current flow through different paths of a parallel branch, the total current for the parallel branch is the sum of the current values in each path.

♦ $V_T = V_1 = V_2 = V_3$
- A parallel branch of a circuit is divided so that each device is connected to the same two points in the circuit
  - For instance in the circuit above, points 1, 2, 3, and 4 are of equal potential. Points 5, 6, 7, and 8 are of equal potential.
  - Therefore the difference in potential across every resistor will be the same.

♦ $1/R_T = 1/R_1 + 1/R_2 + 1/R_3$
- The current in a parallel branch of a circuit is divided at each branch of the circuit, part of the current going through each path. Students should understand conceptually that the current in each branch is only experiencing a fraction of the total resistance, so all of the current is only experiencing a fraction of the total resistance.

Traditional course differentiation

- Understand that the *electromotive force (ℰ)* is the voltage supplied by the source and consider the internal resistance of the source.

Assessment

As stated in the indicator, the major focus of assessment is to compare (detect correspondences) in the ways that current voltage and resistance are measured in series and parallel circuits. Because the indicator is written as conceptual knowledge, assessments should require that students understand the "interrelationships among the basic elements within a larger structure that enable them to function together." In this case, assessments must show that students understand the reasons for the difference in the way that the variables are measured in the two types of circuits based on their knowledge of current flow in the two circuits.